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1 Introduction to TVA's Environmental and Energy Future

Electricity lights our homes, schools, hospitals and businesses. It makes our factories run, powers our computers, television sets and entertainment systems, and even provides transportation “fuel” for electric vehicles. Without electricity, many of us would be hotter in the summer and colder in the winter. Affordable, reliable supplies of electricity have

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become critical to our quality of life, yet very few of us understand the challenges involved in making sure that electricity will be there when it is needed. Reliability of the power supply, affordable and stable rates, as well as the protection of environmental and public health are just a few of the frequently competing objectives that must be considered when determining how to meet future energy needs.

The Tennessee Valley Authority (TVA) is addressing these challenges through its Integrated Resource Plan (IRP) titled *TVA's Environmental and Energy Future*. The IRP is a planning document that outlines and supports TVA's mission and strategy to ensure reliable, low cost power to its customers, while reducing environmental impacts and emissions, encouraging economic development within the Valley, and promoting technological leadership. As such, it is intended to serve as a roadmap for meeting the energy needs of our customers over the next 20 years. It assesses future energy needs and strives to develop a sustainable, flexible approach for meeting them. The IRP establishes strategic direction and flexibility for future decisions in a dynamic, ever-changing regulatory environment.

TVA has renewed its vision to help lead the Tennessee Valley region and the nation toward a cleaner and more secure energy future, relying more on nuclear power and energy efficiency and relying less on coal. The IRP will guide TVA in fulfilling this vision. TVA intends to:

- Lead the nation in improving air quality.
- Lead the nation in increased nuclear production.
- Lead the Southeast in increased energy efficiency.

TVA will accomplish these goals while staying focused on rates, reliability and reputation, and by continuing to fulfill its statutory missions of affordable electricity, economic and agricultural development, environmental stewardship, integrated river system management (navigation, flood control, land management) and technological innovation (including supporting national defense).

As part of this vision, in August 2010, TVA announced the layup of the following nine coal units with a total capacity of about 1,000 MW:

- Two units at Widows Creek in 2011
- Shawnee Unit 10 in 2011 and its evaluation for conversion to a dedicated biomass-fueled unit
- The remaining four older units at Widows Creek within the next four to five years
- Two units at John Sevier within the next four to five years

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The IRP also will be consistent with TVA's 2008 Environmental Policy as well as its 2007 Strategic Plan, in accordance with the mission Congress has set for TVA in the TVA Act.

TVA last completed an Integrated Resource Plan, known as *Energy Vision 2020* (EV2020), in 1995. This plan identified a portfolio of short-term actions that would be implemented by 2002 and long-term actions that would be implemented by 2020. At the time it was undertaken, EV2020 was a comprehensive assessment of alternative strategies for meeting future electricity needs based on projected future conditions in the Valley.



This IRP builds from the foundation set forth in EV2020. A dramatically changing environment in terms of the costs of generating technologies—both construction and fuel costs—as well as a very fluid environment with respect to the regulatory and legislative framework within which TVA operates and is expected to operate, coupled with changing customer demand, has prompted TVA to refresh its long term resource plan to increase the likelihood that the decisions taken will be the best ones possible for TVA and its stakeholders. As with EV2020, TVA is also issuing an environmental impact statement (EIS) in association with this new IRP.

1.1 Brief Description of TVA

The Tennessee Valley Authority was established by an act of Congress in 1933. It is a federal agency and corporation, wholly owned by the United States. In addition to being one of the largest generators of electric power in the nation, TVA is also a regional resource development agency, tasked by Congress with improving the quality of life of the residents of the Tennessee Valley region, fostering economic development, and promoting the conservation and wise use of the region's natural resources.

To help achieve this mission, TVA operates the nation's largest public power system. Its power system currently serves more than nine million people in parts of seven southeastern states encompassing 80,000 square miles.

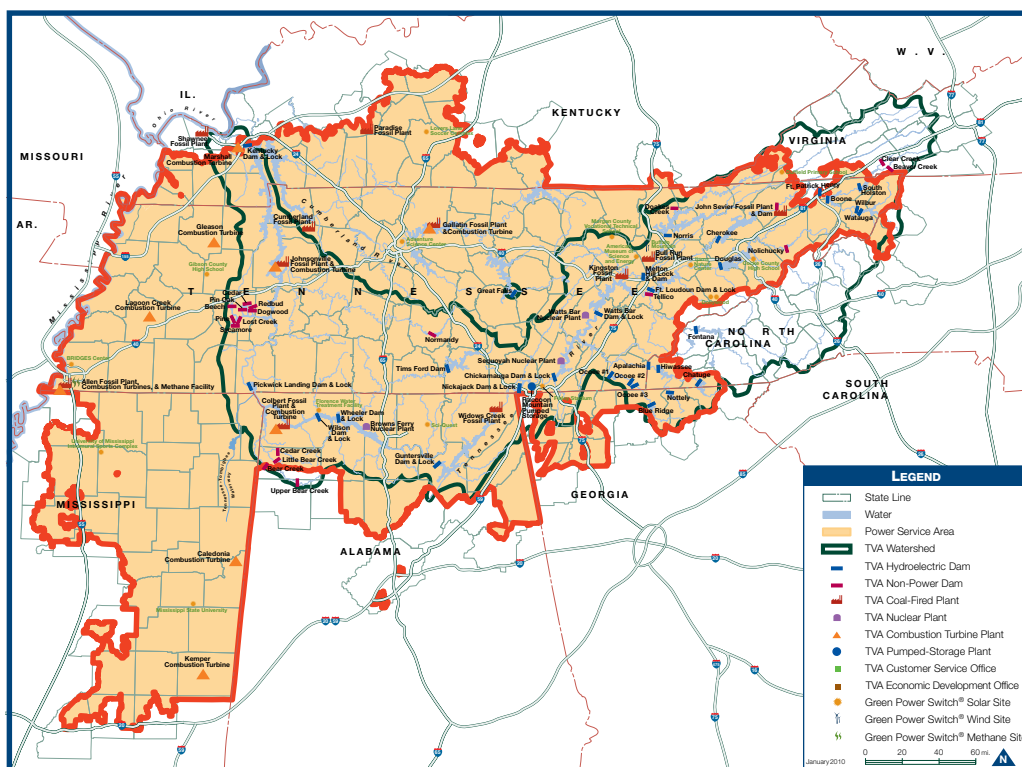
The TVA Act requires the power system to be self-supporting and operated on a non-profit basis. The Act also directs TVA to sell power at rates as low as feasible. TVA receives no appropriations from Congress for its activities and the services it provides to the public. A nine-member Board of Directors sets policy and strategy for TVA. TVA Directors are nominated by the President and confirmed by the U.S. Senate to serve five-year terms.

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1.2 TVA Region and Power System

TVA is the largest public power producer in the United States and is a primary wholesaler of electricity. Its electrical system serves nine million people in an 80,000-square-mile area spanning seven states, including most of Tennessee and parts of Alabama, Georgia, Kentucky, Mississippi, North Carolina and Virginia.

Figure 1-1 – TVA Service Territory



The all-time record peak demand for electricity in TVA's service territory was set on August 16, 2007, at 33,482 megawatts. To meet this demand reliably, TVA operates a diversified generating system with a dependable generating capacity of approximately 37,000 (MW). This generating capacity is made up of six nuclear reactors at three plant sites, two natural gas-fired combined cycle power plants, 11 coal-fired power plants, nine combustion-turbine plants, 29 hydroelectric dams, two diesel generator plants, a pumped-storage facility, a wind farm, a methane-gas co-firing facility, and several small photovoltaic facilities. A portion of this capacity is also provided by third-party operators who sell their output to TVA under long-term power purchase agreements. Electricity is transmitted to 155 local distributors and 56 large industrial and federal installations through a network of approximately 16,000 miles of transmission lines; 487 substations, switchyards and switching stations; and 1,020 individual customer connection points.

TVA delivers electricity to three main customer groups: distributors, directly served customers and off-system customers. Distributors of TVA power, of which there are 155, account for about 81% of total TVA sales and 87% of total revenue. These distributors, which are primarily municipally-operated utilities and distribution cooperatives, resell TVA power to retail consumers metered and billed by the distributors themselves. Municipal utilities make up the largest block of TVA customers. Cooperatives are customer-owned companies, many of which were originally formed to bring electricity to the farthest reaches of the TVA region. Another 19% of total sales, accounting for 13% of TVA's total revenue, are to approximately 50 large industrial customers and six federal installations that buy TVA power directly. Off-system customers buy power from TVA on the interchange market and make up the remainder of TVA's sales and revenue.

TVA Power Contracts govern the relationships between TVA and the 155 distributors of TVA power, including the rate structure under which that power is sold. The contracts provide for a distributor's full requirements, meaning TVA agrees to generate and deliver enough electricity to meet the distributor's full electric load, including reserves, both now and in the future. To meet this contractual commitment reliably, TVA must have a combination of its own generating resources, and contractual rights (through power purchase agreements) to the resources of independent power producers, as well as maintain a highly reliable transmission system to deliver those resources when needed.

1.3 Purpose and Need for Integrated Resource Planning

1.3.1 The Challenge

The size of TVA's power system, and its large influence on the Tennessee Valley region's economy, environment and resources, make integrated resource planning especially important for TVA and the public it serves. The competitive success of businesses and industries in the Valley, as well as the ability to sustain and improve the quality of life for millions of Valley residents, are potentially impacted by the decisions that will be guided by the final result of the IRP process.

Because electricity cannot yet be stored economically in meaningful quantities, the supply of electricity must meet the demand for electricity at all times. This means that electricity providers like TVA must predict what the demand for electricity will be in the future, and then take steps, including the construction of generating capacity or the procurement of purchased power, in order to increase the likelihood it will be able to effectively meet this forecast demand. Given the long lead times involved in planning, permitting and building generating facilities, these forecasts are often 10 to 20 years in length.

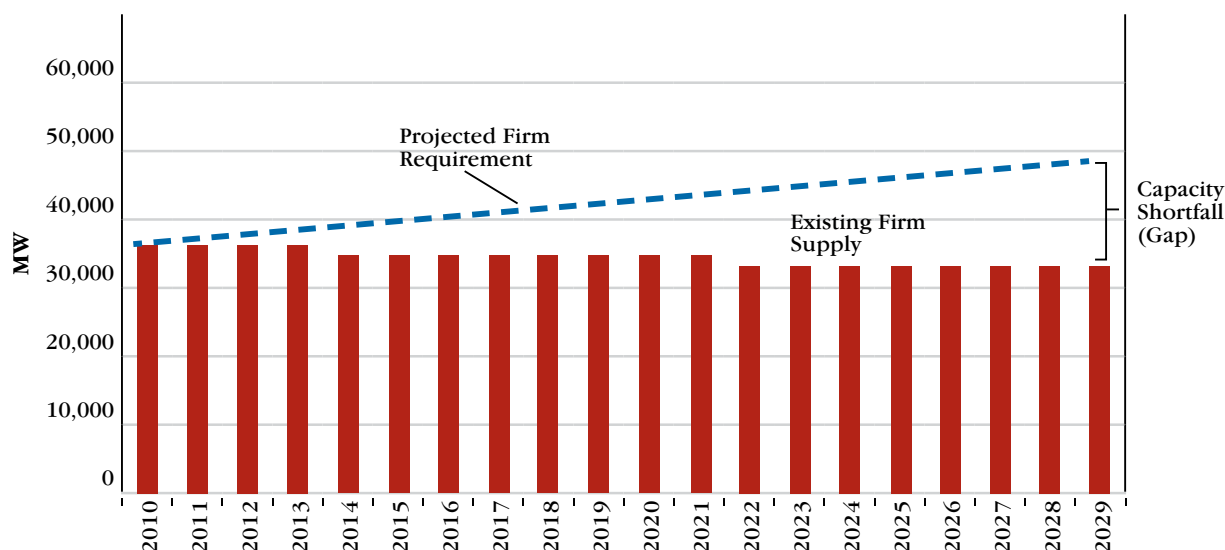
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Transmission expansion also involves long lead times and is a vital component in meeting forecasted demand. Expansion is necessary to enable a number of system modifications, including delivery of new or existing generating capacity to areas of increased demand; retirement of older, relatively higher emission generators; and increased energy import, particularly of renewable energy which tends to be located distant from TVA's service area. Transmission is usually a very cost-effective means of providing power system flexibility, historically costing TVA on the order of 10% of the amount of associated generation additions. However, potential effects on water, vegetation, wildlife and other environmental concerns make this an option that must be evaluated carefully.

In addition to building generating facilities, or acquiring the output of independently owned facilities through long term contracts, TVA can also meet demand through the deployment of programs designed to encourage energy conservation and demand reduction. These activities have associated uncertainty and risk, and designing an effective strategy, and then executing on that strategy, is one of the inherent challenges of resource planning for all electric utilities, including TVA.

TVA is undertaking this IRP process at an especially critical time. Nationally, there appears to be consensus that energy should be produced in cleaner, more environmentally friendly ways—a direction that TVA had already embraced as evidenced by the goals established in its 2008 Environmental Policy.

Figure 1-2 – Capacity Shortfall



It must be recognized by all that achieving these goals, while at the same time keeping electricity affordable for all residents of the Tennessee Valley, will be a challenge, particularly given the difficult economic conditions facing the nation and the regulatory uncertainty facing the industry as a whole. However, TVA is confident it can successfully meet that challenge by working with our stakeholders to design a long-term resource plan that explicitly recognizes the trade-offs that must be made to achieve our common goals of affordable, clean and reliable electricity.

1.3.2 The Role of the Integrated Resource Plan

The IRP will act as a long-term guide that evaluates reliable, cost-effective resource options for meeting future customer demand for electricity subject to economic and operating constraints. A wide variety of resource options (both supply- and demand-side) are considered in order to meet customer demand. These options include conventional power plants, renewable energy sources, energy efficiency, demand response, and power purchases.

The IRP is tasked with meeting future customer demand by identifying any future shortfall in capacity and finding the optimum mix of resources to fill this shortfall. The capacity shortfall (gap) is the difference between the projected firm requirements and existing firm supply. An example is shown in the figure above (Figure 1-1). Existing firm supply includes all existing generating resources as well as approved projects and power purchase agreements. Projected firm requirements include forecasted peak demand adjusted for interruptible loads and a planning reserve margin. The objective of an IRP is to identify a low cost option to close the gap between existing firm supply and projected firm requirement that is also balanced enough to reduce risk and enhance flexibility.

Given the complexity involved in all of these activities, including uncertainty in the forecasts themselves and a constantly changing business and regulatory environment, integrated resource planning is a crucial element of the planning process. Integrated resource planning is built on a foundation of comprehensive, holistic and risk aware analysis. Whereas traditional methods of resource planning focus primarily on generating projects only (i.e. supply), integrated resource planning accounts for demand-side options, which can serve as a very effective offset to growing customer demand.

The integrated approach considers a broad spectrum of feasible supply- and demand-side options and assesses them against a common set of planning objectives and criteria, including cost, risk, rate impact and environmental impact. The Integrated approach is

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also characterized by its participatory and transparent approach, where stakeholders are actively engaged in developing the plan.

In short, the integrated resource planning approach provides an opportunity for planners, and the stakeholders who will be impacted by decisions made by the planners, to address complex issues in a structured, open and transparent fashion.

1.3.3 Impact of The National Energy Policy Act of 1992

The National Energy Policy Act of 1992 established requirements that TVA is required to meet when it carries out its long term planning activities. The goal of a sound long-term plan is to provide energy services to customers at the lowest total cost over the long run.

TVA's integrated resource planning process goes well beyond conventional least-cost planning employed by most utilities in many important ways. For example, like *Energy Vision 2020*, this IRP evaluates the effects of resource options on the Tennessee Valley's environment and its economic well-being, as well as on future prices of electricity and the financial health of TVA. *TVA's Environmental and Energy Future* reflects the results of customer participation and extensive public involvement, including the preparation of an environmental impact statement under the National Environmental Policy Act, which goes well beyond the types of environmental assessments that TVA's peer utilities are traditionally required to carry out as part of their own resource planning activities.

TVA has integrated the components of this programmatic environmental impact statement into the overall integrated resource planning process and preferred plan to develop an environmentally-informed resource plan that focuses on reducing costs and risk, while also improving TVA's environmental footprint. A programmatic level environmental impact statement was developed as opposed to a project or site-specific environmental impact statement because of the broad strategic nature of integrated resource planning.

1.4 TVA's IRP Goals

As discussed earlier in the Introduction, the primary goal of the Integrated Resource Plan is to help ensure that TVA can meet the demand for electricity on its system in a cost-effective, reliable manner with due regard for protection of public health and the environment. TVA will strive to meet these goals by adopting a *preferred* strategy that it believes accounts for the expectations of the majority of our stakeholders, while still supporting its multi-faceted mission of providing low cost, reliable power to its

customers, protecting the environmental resources of the Valley, and serving as a catalyst for economic development in the TVA region. The evaluation of the strategic alternatives considered as part of the IRP involves extensive computer modeling, analysis, review and input from stakeholders and the public, in addition to significant internal evaluation and discussions with TVA's Board of Directors. Constraints, trade-offs and corporate strategic objectives are all considered as the different combinations of certain strategies and uncertain futures are analyzed and weighted. The expectation is that there will not be a single correct answer, but rather a robust plan that best balances competing objectives while reducing costs and risks and retaining the flexibility to respond to future risks and opportunities as they unfold.

A primary goal of the IRP is to engage the public in a transparent process that solicits and ensures public input, while also educating participants on the constraints and trade-offs required to produce a plan of this magnitude. The end result should be a process that all parties involved feel is fair and representative. Input received from the general public and stakeholders is a key part of the IRP process and associated EIS that assists TVA in choosing an adequate resource plan for TVA, its customers, stakeholders and the Valley residents it serves. TVA captures this feedback through outlets such as public briefings, phone surveys, and through its Internet presence at www.tva.gov/irp. A key aspect of public participation is the Stakeholder Review Group, which engaged in development of the IRP throughout the entire process through scheduled working sessions with TVA staff. For a more detailed description of public participation within the IRP process, see Chapter 2.

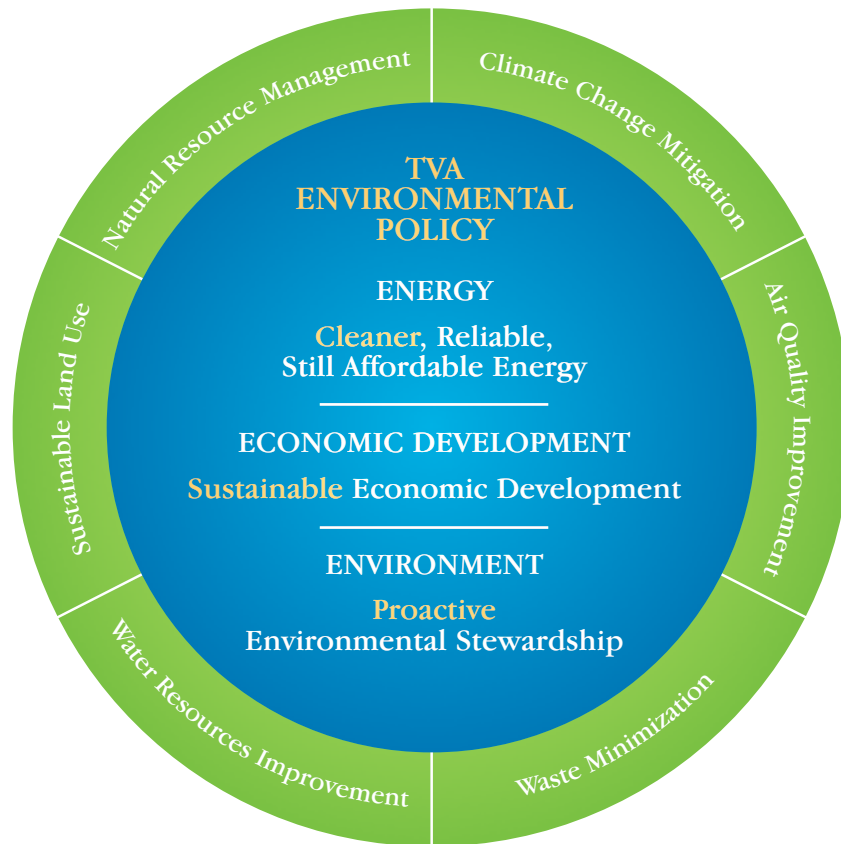
1.5 TVA's IRP Objectives

As previously mentioned, TVA has a multi-faceted mission. The objectives of the IRP are illustrated well in Figure 1-3 on the following page. The ultimate goal of TVA's *Environmental and Energy Future* is to produce a robust resource plan that TVA can follow to produce competitive services to our ratepayers. The IRP's definition of competitiveness goes beyond being a low cost electricity producer; it also means that TVA must be competitive in the quality and value of the electric services it provides. Furthermore, it is measured in terms of TVA's contribution to economic development in the region and the region's environmental quality.

In addition, TVA has modified the typical integrated resource planning process to seek more opportunities for public involvement and improved transparency. When the IRP is completed, TVA wants our stakeholders to feel that the processes were reasonable and that TVA listened to their input.

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Figure 1-3 – TVA Environmental Policy



1.6 The IRP Process

The IRP process consists of six distinct steps:

1. Develop Scope
2. Develop Inputs and Framework
3. Analyze and Evaluate
4. Release Draft IRP and Solicit Public Comment
5. Incorporate Public Comment and Run Sensitivities
6. Identify and Recommend Preferred Strategy

These steps are summarized below and explained in more detail in Chapter 5 – Resource Development Plan and Analysis.

1.6.1 Develop Scope

TVA initiated a public scoping period beginning in June 2009. Public scoping comments addressed a wide range of issues, including the integrated resource planning process, preferences for various types of power generation, increased energy efficiency and demand response (EEDR), and the environmental impacts of TVA's power generation, fuel acquisition, and transmission operations. These comments were crucial in helping the IRP project team identify what the relevant public concerns were with respect to TVA's long term resource planning.

1.6.2 Develop Inputs and Framework

A no-regrets decision making framework is one in which decision makers feel they have analyzed relevant risks, probabilities of certain futures, and the challenges that may be faced adequately so that decisions made have a high likelihood of being sound. In order to facilitate a no-regrets decision framework, TVA is employing a scenario planning approach in development of the draft IRP. Scenario planning provides an understanding of how near-term and future decisions would change under different conditions, which allows for impacts on different courses of action to be analyzed and assessed, and weight given to those actions that may not perform the best in each and every scenario, but perform relatively well in all. Future decisions that produce similar results across different conditions may imply that these decisions provide more predictable outcomes, whereas decisions that result in major differences are less predictable and thus more “risky.”

To begin the process, TVA, in collaboration with its stakeholder group, developed a set of resource planning portfolios (or strategies) that would be analyzed within the framework of the IRP. These strategies consisted of different mixes of generating technologies, including renewables and demand-side options, and formed the framework of distinct resource planning strategies that would then be supplemented as needed with other more flexible resources. (As such, the strategies were designed to reflect key decisions that TVA has direct control to make for the intended duration of the IRP planning horizon.) Significant expert input was used to ensure the feasibility of elements of each of the five strategies, each characterized by a different supply- and demand-side resource mix that were developed for testing.

**Strategies represent business decisions
that TVA has full control over.**

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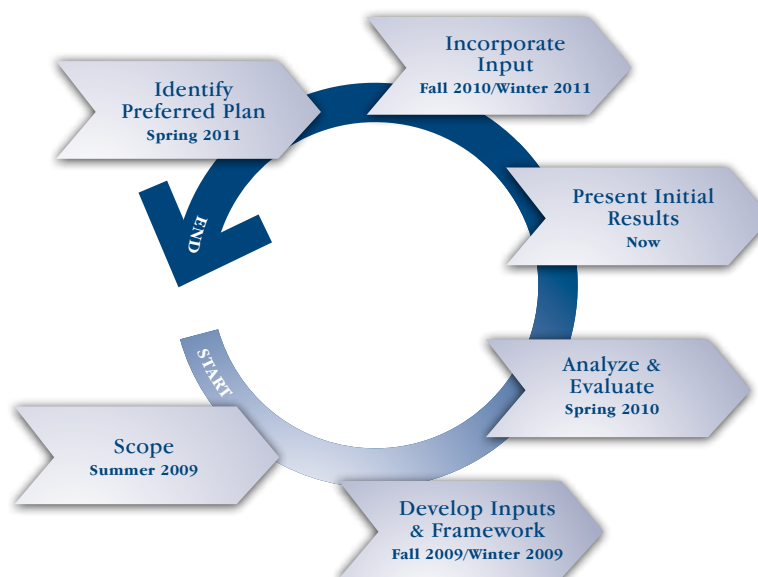
In fall 2009, in order to facilitate a process of no-regrets analysis of the strategies developed above, TVA began to develop a series of scenarios that would be used to

Scenarios represent events that TVA has little or no control over but can have a direct impact on TVA's ability to achieve its goals.

analyze the outcome of resource planning decision strategies. These scenarios would differ from each other in several key areas, including projected

customer demand, future economic conditions, fuel prices, regulatory frameworks and numerous other key drivers. The goal was to identify sets of events, forecasts and other important drivers that TVA could not directly control, but would have a direct impact on TVA's ability to achieve its IRP goals by impacting the resource planning decisions taken within that IRP.

Figure 1-4 – TVA Integrated Resource Planning Process



One way to think of these scenarios is as miniature models of the world. In one model, the economy might stagnate, prices drop and electricity demand stay flat. In another, strong economic recovery could pressure fuel prices, drive interest rates higher, lead to rapid recovery in electricity sales and long term demand growth, and put upwards pressure on the cost of building generating assets. Both scenarios will present dramatically different challenges to any one resource strategy, and the key to sound resource planning is designing a strategy that performs reasonably well, regardless of which scenario most closely captures the actual state of the world in the future.

Seven such scenarios or miniature models of the world were ultimately developed, within which each resource planning strategy was tested for performance.

1.6.3 Analyze and Evaluate

After the inputs, scenarios and strategies were developed, detailed analysis was undertaken of each planning strategy within each one of the scenarios. This phase of the IRP employed industry standard capacity expansion planning and production cost modeling software to develop total cost estimates of each planning strategy in each state of a scenario. Other metrics, including near-term rate impacts, risk and environmental footprint, were also developed using model outputs.

In this manner, the five planning strategies were systematically evaluated within the context of the seven scenarios. In other words, TVA analyzed the hypothetical performance—on a cost, risk and environmental footprint basis—of each strategy on the assumption that the future unfolded in a manner that closely resembled the world specified within each scenario. Ultimately, the development of capacity expansion plans specific to each of the five strategies, for each of the seven scenarios, resulted in a total of 35 unique capacity expansion plans (or “portfolios”), each of which had been optimized to perform well for the specific scenario they had been developed for. Each portfolio represents a long-term, least-cost plan made up of different asset mixes (both supply- and demand-side assets) that could be deployed to meet the power needs of the region.

After all 35 portfolios were developed, each was ranked using selected metrics within the framework of a consistent and standard scorecard. The metrics were chosen based on their importance and centrality to TVA’s mission and included metrics capturing cost, reliability, risk, economic development, environmental stewardship and technology innovation. The ranking is not intended to identify any single strategy as “the best.” Rather, through the process of a consistent analytical ranking exercise, TVA’s Board of Directors and leadership team are provided with information that can be used to help them conduct a trade-off evaluation of decisions pertaining to TVA’s existing generation fleet and available generation options. It also facilitates TVA’s ultimate adoption of a long-term resource planning strategy that will then serve as the foundation for TVA’s near-term business and financial plans.

1.6.4 Release of Draft IRP and Solicitation of Public Comment

The next phase of the IRP process was to present the results to both internal TVA stakeholders and the general public in the form of a draft IRP document and associated EIS. The draft IRP *does not* present a preferred strategy, but rather a number of alternative strategies that TVA is considering. The draft IRP does not include all strategies analyzed. It includes a sampling of unique strategies that represent a broad spectrum of viable options for implementation.

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Similar to the scoping period, TVA encourages public comments on the draft IRP and associated EIS. These comments will aid TVA staff in identifying public concerns and interests in the future operation of the TVA power system. The public comment period begins with the Environmental Protection Agency's publication of the Notice of Availability of the draft IRP and Environmental Impact Statement in the Federal Register. During the public comment period, TVA will hold four public meetings to provide the public information about the IRP and to receive public input during the month of October 2010. These meetings will be located at: Bowling Green, Ky.; Olive Branch, Miss.; Knoxville, Tenn.; and Huntsville, Ala. A schedule of the public meetings is posted on the IRP website at www.tva.com/irp.

TVA will address all substantive comments received during the public comment period in the final IRP and its associated EIS, as appropriate.

1.6.5 Incorporate Public Comment and Additional Modeling

After the public comment period closes, all comments submitted will be taken into consideration and addressed in preparation for publishing the final IRP document. Additional modeling to analyze small changes to the strategies or scenarios will be executed based on both public and internal feedback. Key inputs and assumptions will be revised to reflect current conditions, which will lead to an updated analysis and evaluation of results.

1.6.6 Identify and Recommend Preferred Strategy

After considering public comments and updating, revising and conducting additional analyses as appropriate in the IRP and EIS, TVA staff will identify and recommend to the TVA Board a preferred strategy. This strategy will be identified based on a number of key criteria, including cost, risk, environmental impacts and economic implications. No sooner than 30 days after a Notice of Availability of the final EIS is published in the Federal Register, the TVA Board will be asked to approve an IRP strategy. The Board's decision will be described and explained in a Record of Decision.

1.7 IRP Deliverables

1.7.1 Draft and Final IRP Documents

The IRP will be published twice, once as a draft document and again as a final document. The draft IRP will provide a broad look at all the options TVA has considered and the long-term implications of various business strategies. Following a public comment period and associated revisions, the final IRP will recommend a robust, flexible plan that supports TVA's unique mission of "*serving the Valley through energy, environment and economic development.*" The preferred strategy will entail an outcome that balances costs, efficiency in electricity generation, reliability, energy efficiency, environmental responsibility and competitive rates for customers.

1.7.2 Draft and Final Environmental Impact Statement

As part of the IRP, TVA has also prepared a draft environmental impact statement in accordance with the National Environmental Policy Act (NEPA) 42 USC §§ 4321 et seq., Council on Environmental Quality (CEQ) regulations for implementing NEPA 40 CFR Parts 1500-1508, and TVA's procedures for implementing NEPA. NEPA requires federal agencies to consider the impact of proposed actions and alternatives on the environment before making decisions with potential environmental impacts. The NEPA EIS process provides a structured means of analyzing competing options and for involving the public in TVA's decision-making processes.

TVA will use the draft environmental impact statement, as well as the analyses in the IRP, to select a resource plan for implementation. The EIS will initially be released in draft form, providing the public the opportunity to comment. After addressing public comments, it will be issued in final form for consideration by the TVA Board.